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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/601,896	06/23/2003	Michael J. Borden	6997	7562
20567	7590	09/26/2005	EXAMINER	
SANDIA CORPORATION P O BOX 5800 MS-0161 ALBUQUERQUE, NM 87185-0161			NGUYEN, KIMBINH T	
			ART UNIT	PAPER NUMBER
			2671	

DATE MAILED: 09/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 10/601,896	<b>Applicant(s)</b> BORDEN ET AL.	
	<b>Examiner</b> Kimbinh T. Nguyen	<b>Art Unit</b> 2671	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 23 June 2003.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-31 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 26-31 is/are allowed.
- 6) ☒ Claim(s) 1,3,4,6-12,14,16-20 and 22-25 is/are rejected.
- 7) ☒ Claim(s) 2,5,13,15 and 21 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
     Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
     Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

### **DETAILED ACTION**

Claims 1-31 are pending in the application.

#### ***Drawings***

1. Figures 1A, 1B, 2A, 2B and 3 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.
2. The drawings 1A and 1B are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: 114, 116, 118, 120. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

***Information Disclosure Statement***

3. The information disclosure statement filed 06/23/03 fails to comply with 37 CFR 1.98(a)(2), which requires a legible copy of each cited foreign patent document; each non-patent literature publication or that portion which caused it to be listed; the list of the articles are not match with the articles have been received from the applicants; and all other information or that portion which caused it to be listed. It has been placed in the application file, but the information referred to therein has not been considered. However, Examiner considered the non-patent literature publications have been received in the application file: "Octree-based Generation of Hexahedral Element Meshes", "Generating Multi-Million Element Meshes for Solid Model-Based Geometries: The Dicer Algorithm", "Automatic Remeshing with Hexahedral Elements: Problems, solutions and Applications" and "A new automatic hexahedral mesher based on cutting".

***Claim Objections***

4. Claims 2, 3, 5, 13, 14 and 15 are objected to because of the following informalities: the "steps" have not been labeled or identified in the claims such as a), b), c) .... Appropriate correction is required.

***Claim Rejections - 35 USC § 102***

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 1, 3, 4, 6-12, 14, 16-19, 20 and 22 are rejected under 35 U.S.C. 102(b) as being anticipated by Tautges et al. (5,768,156).

**Claim 1**, Tautges et al. discloses generating a sheet of hexahedral elements from a hexahedral volume mesh (col. 6, lines 40-42), wherein said mesh includes a plurality of three-dimensional (3D) hexahedrons each having six quadrilateral faces and eight nodes, each node formed at three intersecting edges, and wherein said sheet includes a subset of the plurality of 3D hexahedrons (col. 13, lines 10-28); determining a group of hexahedrons within said sheet to refine (col. 14, lines 18-36); shrinking said group (col. 38, line 48 through col. 39, line 55); and inserting a new sheet of hexahedrons into the hexahedral volume mesh (a whisker sheet that resembles a pillow is inserted so that it surrounds the STC 2- or 3-cell that contains the primal star node; col. 39, lines 14-21).

**Claims 3, 14 and 20**, Tautges et al. discloses selecting a hexahedron, the selected hexahedron having three sets of opposing faces from the six quadrilateral faces, each set including a first opposing face and a second opposing face (col. 11, lines 40-65; col. 13, line 9 through col. 14, line 16); determining a neighboring hexahedron to refine, the neighboring hexahedron sharing one face with the selected hexahedron (col. 13, lines 18-22); repeating step b) until all neighboring hexahedrons have been found; selecting the neighboring hexahedron to refine; repeating steps a) through d) until all hexahedrons in the sheet have been found (col. 13, lines 9-36).

**Claims 4, 11 and 22**, Tautges et al. discloses determining a group of hexahedrons includes identifying said group using one of a point (a mesh node), line (chords), and surface of the mesh (col. 11, lines 1-65).

**Claims 6 and 16**, Tautges et al. discloses moving exterior nodes of the group from an original position into the volume of each hexahedron (nodes 1 and 3 can be exchanged; col. 33, lines 1-58); and maintaining a copy of each exterior node in the original position (col. 33, lines 14-34).

**Claims 7 and 17**, Tautges et al. discloses shrinking said group includes pillowing (col. 38, line 56 through col. 39, line 20).

**Claims 8 and 18**, Tautges et al. discloses inserting a new sheet of hexahedrons into the hexahedral volume mesh includes: separating each hexahedron in the group from the hexahedral volume mesh (col. 13, lines 17-25); forming a void in the hexahedral volume mesh (shrink set; col. 38, lines 56-62; col. 39, lines 29-43); and inserting the new sheet of hexahedrons into the void (col. 42, lines 14-19).

**Claim 9**, Tautges et al. discloses generating an initial hexahedral volume mesh, wherein the mesh includes a plurality of three-dimensional (3D) hexahedrons, each 3D hexahedron having six quadrilateral faces and nodes, each node formed at three intersecting edges (col. 13, lines 9-28); determining an area to refine in the initial mesh (col. 11, lines 1-3); generating a sheet from said area, wherein the sheet includes a subset of the plurality of hexahedrons (col. 11, lines 4-28); defining a group of hexahedrons within said sheet to refine (col. 14, lines 18-36); shrinking said group (col. 38, line 48 through col. 39, line 55); and inserting a new sheet of hexahedrons into the

hexahedral volume mesh (a whisker sheet that resembles a pillow is inserted so that it surrounds the STC 2- or 3-cell that contains the primal star node; col. 39, lines 14-21).

**Claim 10**, Tautges et al. discloses generating a sheet includes using a dual of the initial hexahedral mesh (col. 13, lines 38-67).

**Claim 12**, Tautges et al. discloses the initial hexahedral mesh is selected from the group consisting of an all-hexahedral swept mesh, multiple all-hexahedral swept meshes for a subdivided geometric entity, a quadrilateral mesh from a source surface to a target surface, and combinations thereof (col. 6, lines 40-56).

**Claim 19**, the rationale provided in the rejection of claims 1 and 8 are incorporated herein. In addition, Tautges teaches a controller for performing the steps (col. 2, lines 7-21).

### ***Claim Rejections - 35 USC § 103***

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 23-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hannerman "Improving the Surface Cycle Structure for Hexahedral Mesh Generation", ACM 2000 in view of Dhondt "A new automatic hexahedral mesher based on cutting", published 2001.

**Claims 23-25**, Hannerman discloses inserting a volume into a hexahedral volume mesh forming an intersection (to insert two-manifold), wherein the mesh includes 3D hexahedrons, each 3D hexahedron having eight nodes, each node formed at three intersecting edges (self-intersecting); inserting a layer of elements on each side of the volume (inserting an additional dual cycle); removing the volume (to remove parallel dual edges; see pages 19-27). Hannerman does not teach nodes; however, Dhondt teaches each 3D hexahedron having eight nodes, each node formed at three intersecting edges (see section 4); moving nodes in the hexahedral mesh to surface of intersection with the volume (the nodes belonging to the intersected edges are moved; see section 3, page 2111). It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the node allocation taught by Dhondt into the cutting method of Hanneman, because it would provide a smoother mesh.

***Allowable Subject Matter***

9. Claims 2, 5, 13, 15, 21 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

10. Claims 26-31 are allowed.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kimbinh T. Nguyen whose telephone number is (571) 272-7644. The examiner can normally be reached on Monday to Thursday from 7:00



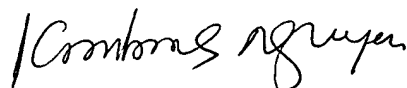
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AM to 4:30 PM. The examiner can also be reached on alternate Friday from 7:00 AM to 3:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka Chauhan can be reached at (571) 272-7782. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

September 22, 2005



**KIMBINH T. NGUYEN**  
**PRIMARY EXAMINER**